

LIFE HISTORY OF CALEPHELIS MUTICUM
(McALPINE); LEPIDOPTERA.

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Calephelis muticum (McA.) was described in the April, 1937, issue of this publication. As noted in that issue this little butterfly had been mistaken for *Calephelis borealis* (G. & R.) by many lepidopterists, including the author, and its discovery was a direct result of the following life history work and comparison with similar work on *Calephelis borealis* (G. & R.) by Cyril F. dos Passos, as published in August, 1936, issue of the *Canadian Entomologist*. Mr. dos Passos very kindly assisted in this comparison and furnished the author with specimens of *borealis* together with egg and caterpillar molts of various stages. Mr. J. F. Gates Clarke, of the National Museum, prepared genitalic slides of both species which further showed conclusively the distinctness of the two.

Through the kind co-operation of several lepidopterists, acknowledged in my paper of last year, the distribution of *Calephelis muticum* as recorded at that time was as follows: In southern Michigan near Detroit and Three Oaks; in Wisconsin near Milwaukee; in Illinois near Chicago; in Ohio near Columbus, and in Missouri near Willard. Its range has been further extended during the past year by collection of several specimens by the author at Lamberton Lake near Grand Rapids, Michigan, and by the record of one specimen collected by R. L. Chermock in July 26, 1932, near Pittsburgh, Pennsylvania.

Observations on this little butterfly extend through several seasons and were made mostly in one locality, Bloomfield Hills, Michigan, which is located about twenty miles northwest of Detroit. It was first found there many years ago by Dr. W. W. Newcomb, of Ann Arbor, Michigan, an ardent lepidopterist, to whom I am greatly indebted for assistance and encouragement in this work. This particular habitat (on Barbour Estate) is in the rather broad valley of a small stream, a branch of the River Rouge, in which there is a medium sized swamp and springy area. Tamarack trees predominate in the swamp area and marsh grasses, shrubby cinquefoil, and small shrubs and bog vegetation are found on the open springy ground. The surrounding country is hilly or rolling and when wooded the usual hardwoods predominate. The whole area may be classed as typical glacial morainic belt region, with many small lakes, streams, hills and swamp areas. *Calephelis muticum* was found in small numbers in the open springy area adjoining the small stream. The butterflies are weak fliers and are easily caught while

flying around among the lower marsh plants and grasses. They were occasionally attracted to the flowers of the yellow daisy and shrubby cinquefoil. When resting they spread their wings showing the upper surface.

As far back as August 1, 1915, its food plant, the swamp thistle, was discovered by the author, by noting oviposition by a female in the field. Ninety fertile eggs were obtained from three females confined over this food plant at that time. My records show that forty-two eggs were laid by one of these females. The early caterpillar stages were observed at this time but efforts to carry the caterpillars through the winter of 1915 and 1916 were unsuccessful. Observations were made, however, in the spring of 1916 on caterpillars found in the field and five were reared to maturity, chrysalis and imago, but there was some question as to the exact number of caterpillar stages. A very few fertile eggs were obtained in late summer of 1916 and early caterpillar stages were noted again but as in the previous winter I did not succeed in carrying them through the winter. No further life history work was done on this butterfly until the summer of 1930 when forty fertile eggs were obtained at the Bloomfield Hills bog by confining females over the food plant. Of this batch four caterpillars were carried through the winter of 1930 and 1931 and complete records were obtained of these to imago. Again in the summer of 1936 a dozen fertile eggs were obtained from the Willis swamp (type locality of male holotype). This swampy area is located at the northeast corner of Crane and Willis roads in Washtenaw County about five miles southwest of Ypsilanti. This habitat is a rather small open, marsh-grassy area, formerly part of or adjoining tamarack swamps, with small water courses running through it and which is now being grazed over by cattle. A few years ago the butterfly was very common here but last year very few were noted, due I believe to the cattle grazing and consequent destruction of food plant. Of this batch of eggs, four were carried through the winter of 1936 and 1937 and complete records were obtained of these through to chrysalis and imago. My records indicate that one of these caterpillars molted eight times (or had nine instars) before going into chrysalis, while all other complete records of caterpillars of this butterfly indicate but seven molts or eight caterpillar instars. Mr. dos Passos records a similar apparent abnormal ninth instar of one caterpillar in his life history of *Calephelis borealis*. There seems to be considerable irregularity in the length of time spent by caterpillars in the various instars which I believe is largely due to variation in weather conditions during different years.

The life history of *Calephelis muticum* may be briefly stated as follows: It is single brooded, and the flying season in this vicinity is for about two weeks, between July 10 and August 10, depending upon the season. The natural food plant is the swamp thistle (*Cirsium muticum*), although I have succeeded in raising caterpillars on the bull thistle. The egg is usually laid on the underside of the leaf on the lower half, either on top of the midrib or along the edge of it. The smaller and younger plants of the swamp thistle, which are more hairy on the underside of the leaves and which grow on slightly dryer ground, are preferred. The eggs are usually laid the latter part of July in this vicinity and the duration of egg stage is from 16 to 28 days. The caterpillar molts three or four times, usually the latter number, before going into hibernation for the winter. It hibernates at the base of the smaller leaves of the swamp thistle. The frosts do not seem to kill these smaller leaves, but the larger ones die down, leaving only a rosette of small, very hairy leaves, that lie down rather flat and close to the ground and overlap each other. The caterpillar eats off a few of the hairs on the under side of one of these smaller leaves, and on the lower half of the leaf, making a little pocket or clearing about the size of the caterpillar, where it hibernates for the winter. With the first continued warm weather of the spring, usually from April 15 to May 15 in this vicinity, the caterpillar becomes active and starts to feed. Four caterpillars which I succeeded in carrying through the winter of 1930 and 1931, all molted four times before hibernation and molted three more times in the spring before the final molt upon going into the chrysalis, which was from July 1 to July 4. These hatched into the butterfly from July 13 to July 17. From observations, under natural conditions, the chrysalis is not usually attached to its own food plant, but to the underside of some small leaf close to the ground, such as a violet leaf, and within six or eight inches of the swamp thistle, upon which it fed. The chrysalis is covered with the white hairy matted mass of the last molt, which gives it the appearance of being enclosed in a loose white hairy cocoon.

There are some interesting habits and characteristics of the caterpillar which are worthy of note: (1) The caterpillar in emerging from the egg, eats a round hole through the central micropyle, leaving the balance of the egg intact, no effort being made to eat it. (2) The caterpillar seldom eats any portion of the molted skin and no difficulty was experienced in finding this, as it is usually fairly well fastened by little hooks on the prolegs, to the food plant. (3) The caterpillar is sluggish, does not move around very much, and does not eat as ravenously as most caterpillars do. During its

earlier states it feeds on the fleshy leaf tissue on the underside of the leaf, leaving the tougher upper skin of the leaf intact, causing this skin to dry up and look like white transparent patches on the leaves, thus making it easy to detect the caterpillar on the plant. In the later stages it eats completely the tenderer part of the leaf, which is the outside edges. At rest the caterpillar is usually found on the underside of the leaf and close to the midrib. (4) Some difficulty was experienced in keeping the hibernating caterpillars through the winter, but I finally was successful by leaving them on their food plant, outside, and under natural conditions as much as possible. An easy way to obtain perfect specimens of the butterfly is to obtain the larvae in its last state, when they are readily detected on the food plant during the latter part of June. No enemies of the caterpillar were detected. (5) As noted in the drawings, the appearance of the caterpillar is very interesting because of the two mid-dorsal rows of long white hairs which extend upward, as well as the long white lateral, depressed hairs which form a complete fringe around the caterpillar. In trying to remove the caterpillar from the leaf, one may sometimes experience a little difficulty, as these long white lateral hairs flattened against the leaf, help the caterpillar to retain its hold. At other times, particularly in the earlier stages, the caterpillar when disturbed, will curl up and drop to the ground. (6) An interesting feature of the clothing of the caterpillar is the numerous minute vitreous sprocket-shaped processes, which cover the dorsal surface in all stages except the first. These processes give the surface a whitish or pubescent appearance when not under magnification, the usual ground color of the caterpillar being a pale bluish green, with no other coloring or markings. (7) The arrangement of spiracles on first thoracic and first abdominal segments, just below the lateral warts which support the long horizontal white hairs is perhaps unusual. In the former they are located at posterior edge of segment while in latter at anterior edge.

Egg:

Turban shaped—the color is a delicate coral pink or carrot red when first laid, becoming waxy white just before hatching. It is firmly attached at its base to the leaf, by a vitreous secretion. Its surface is a vitreous raised network of five, six, seven and eight-sided cells, which are arranged in concentric rows about the central micropyle. The cells are largest near the micropyle and progressively becoming smaller and less prominently raised toward the base of the egg, where they

are practically obliterated. The intersections of the cell network are enlarged into blunt thickened knobs, while the ridges between are thinner and lower. The base of the egg is flattened, while its top is depressed and cut off squarely to form a broad shallow pit with radiating cells as sides, whose bases are joined and thickened to form a slightly raised circular rim about a very fine network, which forms the central micropyle. These radiating cells are usually eleven, though sometimes twelve in number and are generally five sided, though occasionally one or two are six sided. There seems to be a great variation in arrangement and number of different sided cells, no two eggs being exactly alike. Size of Egg—Vertical 0.3 mm., Horizontal 0.6 mm. Duration of state—16 to 28 days—July 15 to August 10. Number observed 90.

NOTE: In the following description of caterpillar instars the average length of caterpillar is measured from front of head to end of last segment at beginning of instar, while the dates indicated are approximate for vicinity of Detroit, and vary considerably from season to season.

First Instar:

Length about 1.3 mm., ventral side flattened, dorsal side rather wedge shaped, being somewhat flattened in mid-dorsal area. The dorsum is highest at first abdominal segment, head oval, nearly as broad as front of first thoracic segment, face very finely granulated and bearing a number of colorless bristles, ocelli black in crescent cluster, mandibles and labrum brown, color of head pale lemon yellow, shining, not retractile. The caterpillar when first hatched is of a dull whitish clay color on dorsal surface, but after feeding becomes whitish green and between segments darker green. Spiracles white, turning yellowish toward latter part of instar. Thoracic feet and prolegs pale lemon yellow, shining. Ventral surface pale lemon yellow. A conspicuous feature of the caterpillar is the two mid-dorsal rows of long white hairs which extend upward and backward and a lateral row of long white hairs which form a complete fringe around the caterpillar. These long white hairs, under considerable magnification, have rather blunt points, are round and are covered with very minute bristles, often brownish in color, giving a light brownish tinge to some of these long hairs. The dorsal surface between the long white hairs is very minutely granulated. There are low tuberculated warts or enlargements along mediodorsal line on each seg-

ment, which support long whitish hairs. The first thoracic segment is narrowed in front and somewhat flattened mid-dorsally, to form a shield shaped wart or process, with a thickened rounded rim along the front, which supports long whitish hairs that project out over the head. There are sixteen such projecting white hairs, half of which are quite long, the longest being about 0.7 mm. From second thoracic to eighth abdominal segments inclusive the mediodorsal warts support two rows of tubercles, one on each side of mediodorsal lines from which arise the long whitish hairs. These hairs extend about 0.3 mm. above dorsum. On first and second thoracic segment there is one such hair on each side of mediodorsal line, while from first abdominal to eighth abdominal there are two such hairs. The ninth abdominal segment is much narrower and more flattened out and from its outer thickened edge, long whitish hairs project out horizontally and upward, ten in number, the longest being about 0.8 mm. in length. Just below the anal opening are two featherlike spines which are downward projected and are used for throwing the excrement away from the caterpillar. When the excrement is passed, it falls on these spines, the caterpillar then jerks its abdomen upward and throws the excrement usually over its head. The sub-stigmatal fold so called consists of somewhat horizontally flattened warts or enlargements, one to each segment from second thoracic to eight abdominal. These warts or enlargements each support a pencil or tuft of long horizontally projected whitish depressed hairs which together with hairs on first thoracic and ninth abdominal segments form a continuous fringe around the caterpillar. These lateral warts on second and third thoracic segments support a pencil of three long white hairs, while the lateral warts on first abdominal support four, and on second abdominal to seventh, five such hairs, one of which is very short and downward projected, and on eighth abdominal seven such hairs. Just above the prolegs on first, second and third thoracic segments is a fork of two short white hairs while midway between mid-dorsal and lateral warts on second and third thoracic segments is a small colorless bristle. The arrangements of spiracles is interesting and has been referred to previously. Duration of stage from 11 to 16 days—Aug. 9 to Aug. 20. Caterpillars observed 40.

Second Instar:

Length of caterpillar about 1.9 mm. Shape of caterpillar

and arrangement of warts and tubercles as in first instar, although dorsal and lateral tubercles supporting long whitish hairs are now more prominent, making sutures appear more deeply cut. The long whitish hairs of mediodorsal area and lateral fringe are much more numerous than in preceding stage. The hairs on mediodorsal warts from second thoracic to eighth abdominal segments are more numerous and not nearly so long in proportion to height of body and are projected more directly upward than in preceding stage. The tubercles located on mediodorsal warts or enlargements from second thoracic to eighth abdominal segments are arranged as in former stage and now each supports a pencil or tuft of long whitish hairs instead of single hairs. A new element in the clothing of the caterpillar appears for the first time. The dorsal surface between the mediodorsal long hairs and lateral fringe is now studied with minute sprocket shaped vitreous processes, scarcely raised above the surface, which give a whitish or velvety appearance to latter. Most of these processes have six rays, although some have five, seven or even eight or nine rays of more or less regular length. At the center of each process is a slight round depression. Just below the anal opening are two pencils of four short hairs, downward projecting which replace the feather like ones of preceding instar. Color of caterpillar, dorsal surface, whitish green. Head smaller and narrower than in preceding stage, color pale lemon or cream. Duration of stage from ten to thirteen days—August 20 to September 1. Caterpillars observed 32.

Third Instar:

Length 2.8 mm., general shape, color and arrangements of tubercles and hairs as in preceding stage, only there are more hairs on all the tubercles. These hairs on the mediodorsal tubercles are a trifle longer and slope more backward than in preceding instar. The sprocket-shaped processes are more numerous on the dorsal surface. Duration of stage from eleven to sixteen days—September 1 to September 15. Caterpillars observed 30.

Fourth Instar:

Length 3.4 mm., general appearance, shape, color and arrangement of tubercles and hairs as in preceding stage. The dorsal and lateral hairs are slightly longer and more numerous. The sprocket shaped processes are more numerous over dorsal surface. There are very small pits which appear as dark

spots on each segment, from second thoracic to eighth abdominal, between the lateral and dorsal rows of hairs. There are about three or four of these to each segment. These were not noted in preceding stage. Spiracles are pale yellow. There are a number of short white bristles on the prolegs and thoracic feet. Often on the dorsal surface there is a small white bristle near each spiracle or along the edge of the segmental sutures, just below the spiracles. The mediodorsal warts on the abdominal segments in addition to supporting tubercles with long white hair, also bear a number of very small flat rounded, dark, shiny tubercles, which lie on each side of medial dorsal line between the hair bearing tubercles. Duration of stage nineteen to twenty-five days. Some caterpillars may hibernate through the winter in this state—September 5 to October 5. Caterpillars observed 25.

Fifth Instar:

Length 4.3 mm., general shape, color and arrangement of tubercles and hairs as in preceding stage. The dorsal and lateral hairs are a trifle shorter in relation to body. Hibernation through the winter usually occurs in this stage. The dorsal surface besides being studded with the vitreous sprocket shaped processes, is scattered in spots with very minute raised black dots between the latter, which appear like dark patches under low magnification. As before noted, the dorsal surface has always been very finely granulated, but not until this stage have any considerable number of these granulations been black. I noted a few in the fourth instar and from my observations it would appear that practically only hibernating caterpillars, have the patches of black granulations. The long dorsal and lateral hairs of caterpillars which have hibernated through the winter have a yellowish or ochre appearance. Besides hibernation through the winter in this stage, an average of twenty days before hibernation in the fall and fifteen days after hibernation in the spring is spent in this stage, October 5 to May 20. Caterpillars observed 22.

Sixth Instar:

Length 5.8 mm., similar in shape to, color and arrangement of tubercles and hairs as in, preceding instar. The middorsal hairs are longer in proportion to body. The black granulations are absent, sprocket shaped processes and white hair are more numerous. Duration of stage from nine to eleven days—May 25 to June 8. Caterpillars observed 8.

Seventh Instar:

Length 7.2 mm., caterpillar similar to preceding stage, only middorsal hairs are not so long in proportion to body. In its latter stages the caterpillar becomes more flattened or slug shaped and its head is inclined to be somewhat retractile. Its general appearance except for long white hairs is becoming more similar to Lycaenid larvae. Duration of stage from twelve to seventeen days, June 8 to June 25. Caterpillars observed 8.

Eighth Instar:

Length 10.5 mm., just after seventh molt and 15 mm., at end of instar; hardly distinguishable from preceding instar except for size. The drawings as illustrating the fourth and sixth instars are very similar to this stage except that the long hairs on mediodorsal tubercles slope more backward. The caterpillar is inclined to wander off its food plant after becoming full grown, to pupate. Duration of stage from thirteen to sixteen days—June 25 to July 10. Caterpillars observed 8.

Ninth Instar (probably abnormal):

As noted before only one caterpillar was observed as having reached this instar. This caterpillar was eleven days in eighth instar and twelve days in ninth instar. General appearance of caterpillar same as in eighth instar. Length of mature caterpillar 16 mm.

Chrysalis:

Length 9.8 mm., greatest breadth across abdomen near end of wing cases 3.9 mm., breadth across mesothorax 3.5 mm. Dorsal surface rounding or cylindrical, while ventral surface is somewhat flattened, especially so in abdominal segments. Abdomen rather long, sloping gradually to posterior extremity which is flattened slightly to form cremaster, the latter being small and provided with minute hooklets. Head case rather squarely cut off, sides rounded. Thoracic area rounded, short and considerably elevated. Along edge of headcase is a fringe of minute colorless branching or hooked bristles. On dorsal surface of thorax are scattered minute colorless hooked bristles. Spiracles occur on second, fourth, fifth, sixth and seventh abdominal segments. Just below each spiracle on fourth, fifth, sixth and seventh segments is a tuft of minute colorless hooked bristles which occur also on eighth abdominal segment.

Scattered minute branching colorless bristles occur on surface of abdomen, more thickly placed on mediodorsal area. Coloration of thorax, headcase and wing covers, pale water green, abdomen a lighter yellowish green. There is a mediodorsal row of small black spots on abdominal segments, also small black spots on thorax and headcase as indicated in drawing. Spiracles black, being more conspicuous and ringed with black on second abdominal segment. Out of seven chrysalides, five conform very closely in coloration with above description, but the other two in addition are mottled more or less with dark green or blackish blotches on abdomen and thorax, but not on wing cases. The chrysalis is suspended by a silken girdle at suture between thorax and abdomen, and is rather closely compressed to surface on which pupation occurs. It is rather evenly covered with the matted mass of cast off long white hairs, star like processes and other exuviae of the last caterpillar stage, which gives it the appearance of being enclosed in a loosely woven hairy cocoon. The cast off hair and exuviae are held in place around the chrysalis by the minute hooked bristles on the surface of the latter. A day or so before the butterfly emerges from chrysalis, the wing covers first, then thoracic region become black, the butterfly emerges through a neat slit along mediodorsal line of thorax and head case, leaving the cast off pupa case practically intact. Duration of stage ten to fourteen days—July 2 to July 22. Specimens observed 7.

A comparative study of the life histories of *Calephelis muticum* and *Calephelis borealis* would indicate they were quite similar. As noted the food plants are different, *muticum* feeding on the swamp thistle (*Cirsium muticum*) and *borealis* feeding on *Senecio obovatus* according to Mr. dos Passos; the former being found in low swampy ground while the latter on higher ground. The eggs are very similar, while the caterpillar stages are also very similar both in appearance and length of stages. One marked difference in appearance of caterpillars is that there are no markings whatever on caterpillars of *muticum* while there are small black spots on dorsal surface of certain segments of *borealis* caterpillars, as recorded by Mr. dos Passos, during most of its stages. The chrysalis with its cocoon like covering of cast-off hairs and exuviae of last caterpillar stage is very similar in both species. The flying period of *borealis* is early part of July while *muticum* is usually later in July or first part of August.